



Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

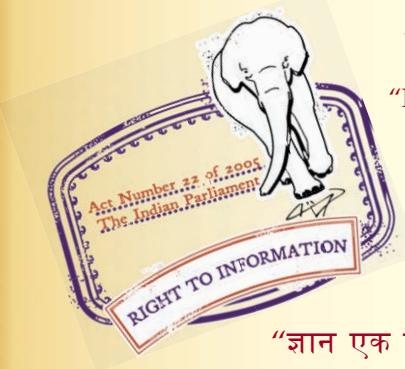
“Step Out From the Old to the New”

IS 11322 (1985): Method for partial discharge measurement in instrument transformers [ETD 34: Instrument Transformers]

“ज्ञान से एक नये भारत का निर्माण”

Satyanareshwar Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartṛhari—Nītiśākām

“Knowledge is such a treasure which cannot be stolen”



BLANK PAGE



PROTECTED BY COPYRIGHT

Indian Standard
METHOD FOR
PARTIAL DISCHARGE MEASUREMENT IN
INSTRUMENT TRANSFORMERS

UDC 621.314.322.8 + 621.314.224.8 : 621.317.333.6.082.77



© Copyright 1985

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard
METHOD FOR
PARTIAL DISCHARGE MEASUREMENT IN
INSTRUMENT TRANSFORMERS

Instrument Transformers Sectional Committee, ETDC 34

Chairman

Representing

SHRI L. S. NEGI

Jyoti Ltd., Vadodara

Members

SHRI V. B. DESAI (*Alternate to*
Shri J. S. Negi)

SHRI C. D. BAGUL Siemens India Ltd, Bombay
SHRI S. M. KELKAR (Alternate)

SHRI S. M. KELKAR (Alternate)
SHRI A. K. BARMAN The Calcutta Electric Supply Corporation Ltd,
Calcutta

SHRI K. C. BHATTACHARYYA (Alternate)
SHRI V. K. BATRA National Physical Laboratory (CSIR), New Delhi

SHRI V. K. BATRA National Physical Laboratory (CSIR), New Delhi
SHRI V. N. SHARMA (Alternate)
SHRI P. V. DAKSHINAMURTHY Tata Consulting Engineers, Bombay

SHRI P. V. DAKSHINAMURTHY Tata Consulting Engineers, Bombay
SHRI R. C. BAJPAI (*Alternate*)

SHRI R. C. BAJPAI (Alternate)
SHRI J. J. DARUWALA All India Instrument Manufacturers and Dealers
Association, Bombay

SHRI C. P. SOOD (*Alternate I*)
SHRI O. P. PURI (*Alternate II*)
Association, Bombay

SHRI O. P. PURI (*Alternate II*)
SHRI P. S. DESHMUKH Maharashtra State Electricity Board, Bombay
S. S. K. (*Alternate I*)

SHRI S. G. KASHI (*Alternate*)
SHRI N. S. DESHPANDE Gilbert and Maxwell, Bombay

SHRI N. B. KULKARNI (Alternate)
DIRECTOR (PROTECTION & Central Electricity Authority, New Delhi

DIRECTOR (PROTECTION & INSTRUMENTATION) DEPUTY DIRECTOR (PROTECTION) Central Electricity Authority, New Delhi

DEPUTY DIRECTOR (PROTECTION
& INSTRUMENTATION (Alternate)
SHRIKANT GARG Inspection Wing, Directorate General of Supplies &

SHRI K. L. GARG **Inspection Wing, Directorate General of Supplies & Disposals, New Delhi**

SHRI R. P. SEHGAL (*Alternate*)
SHRI K. GOPALCHOUDHARY
S. S. D. I.
Vamet Industries, Hyderabad
Sillanpur Road

SHRI S. D. JINSIWALE Silkaans, Bombay
SHRI S. R. ALURKAR (Alternate)

DEPUTY DIRECTOR (I)-3 (*Alternate*)

(Continued on page 2)

© Copyright 1985

INDIAN STANDARDS INSTITUTION

This publication is protected under the *Indian Copyright Act* (XIV of 1957) and reproduction in whole or in part by any means except with written permission of the publisher shall be deemed to be an infringement of copyright under the said Act.

(*Continued from page 1*)

| <i>Members</i> | <i>Representing</i> |
|--|---|
| SHRI P. K. LAL | Madhya Pradesh Electricity Board, Jabalpur |
| SHRI S. K. DIXIT (<i>Alternate</i>) | |
| SHRI S. K. LAMBA | Voltas Ltd, Thana |
| SHRI K. C. MOHANRAJ | The Bombay Electric Supply and Transport Undertaking, Bombay |
| SHRI A. A. SEQUERA (<i>Alternate</i>) | |
| SHRI V. V. MOOGI | Crompton Greaves Ltd, Bombay |
| SHRI A. K. GOVIL (<i>Alternate</i>) | |
| SHRI R. NATARAJAN | Central Public Works Department, New Delhi |
| SURVEYOR OF WORKS (ELECTRICAL)-I (<i>Alternate</i>) | |
| SHRI V. D. PATEL | Gujarat Electricity Board, Vadodara |
| SHRI P. U. PATWARDHAN | Prayog Electricals Pvt Ltd, Bombay |
| SHRI A. V. NARKE (<i>Alternate</i>) | |
| SHRI O. P. PURI | Automatic Electric Ltd, Bombay |
| SHRI S. V. KARKHANIS (<i>Alternate</i>) | |
| SHRI T. R. RAMAN | Tata Hydro-Electric Power Supply Co Ltd, Bombay |
| SHRI D. A. SATHI (<i>Alternate</i>) | |
| SHRI S. C. SARKAR | Nagpur Transformers, Nagpur |
| SHRI M. RAMAKRISHNAN (<i>Alternate</i>) | |
| SHRI P. S. SATNAM | Punjab State Electricity Board, Patiala |
| SHRI B. S. SHARMA | Uttar Pradesh State Electricity Board, Lucknow |
| SHRI D. SURYANARAYANA | Bharat Heavy Electricals Ltd, New Delhi |
| SHRI A. V. SOMAN (<i>Alternate</i> I) | |
| SHRI H. S. VALIA (<i>Alternate</i> II) | |
| SHRI N. THYAGARAJAN | Tamil Nadu Electricity Board, Madras |
| SHRI S. K. RAMASUBRAMANIAN (<i>Alternate</i>) | |
| SHRI J. M. UDIA | Directorate General of Technical Development, New Delhi |
| SHRI L. GOPAL KRISHNA (<i>Alternate</i>) | |
| SHRI B. K. VENKATESH | Karnataka Electricity Board, Bangalore |
| SHRI S. P. SACHDEV, Director (Elec tech) | Director General, ISI (<i>Ex-officio Member</i>) |

Secretary

SHRI SUKH BIR SINGH
Deputy Director (Elec tech), ISI

(*Continued on page 8*)

Indian Standard

METHOD FOR

PARTIAL DISCHARGE MEASUREMENT IN

INSTRUMENT TRANSFORMERS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 29 May 1985, after the draft finalized by the Instrument Transformers Sectional Committee had been approved by the Electro-technical Division Council.

0.2 This standard has been prepared to cover the method for partial discharge measurements in instrument transformers.

0.3 In the preparation of this standard assistance has been taken from IEC Pub 44-4 (1980) 'Instrument transformers, Part 4 Measurement of partial discharge'; issued by the International Electrotechnical Commission (IEC).

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the method of measurement of partial discharges in current and voltage transformers.

1.2 The capacitive part of capacitive voltage transformers should be tested according to IS : 9348-1979†.

*Rules for rounding off numerical values (revised).

†Coupling capacitor and capacitor divider.

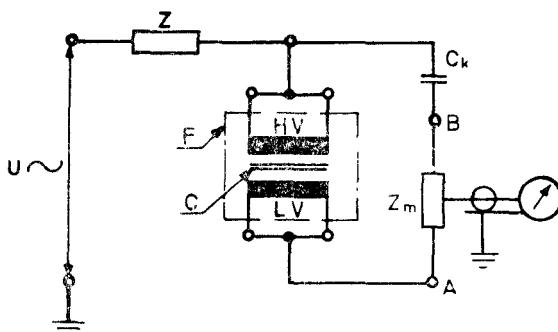
1.3 The minimum voltage levels for which this standard applies are as follows:

- a) solid insulation : $U_m = 7.2 \text{ kV}$,
- b) liquid immersed insulation : $U_m = 72.5 \text{ kV}$,
- Um = highest voltage for equipment.

1.4 This standard can be applied to unconventional systems (for example, gas-filled or gas-immersed) for which less experience is available than for the conventional systems, but their permissible discharge levels shall be subject to agreement between manufacturer and customer.

2. TEST CIRCUITS

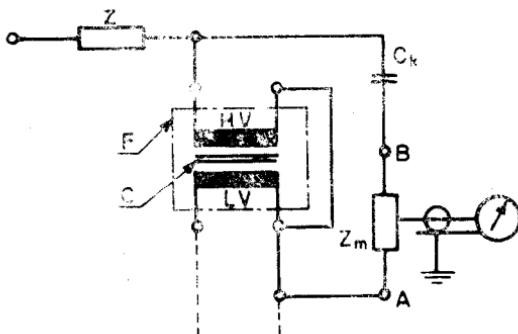
2.1 Current Transformers and Phase-to-Earth Voltage Transformers — The test circuit for the measurement of partial discharges in current transformers and phase-to-earth voltage transformers shall be in accordance with the test circuits shown in 3.2 of IS : 6209-1982*. For detailed application, reference should be made to Fig. 1 and 2 of this standard.



- C : core
- C_k : coupling capacitor
- F : frame
- HV : high voltage winding(s)
- LV : low voltage winding(s)
- Z : filter (optional)
- Z_m : measuring impedance

Either A or B may be earthed.
C and F to be connected to LV whenever possible

FIG. 1 TEST CIRCUIT FOR PARTIAL DISCHARGE MEASUREMENT OF CURRENT TRANSFORMERS



C : core
 Ck : coupling capacitor
 F : frame
 HV : high voltage
 winding(s)
 LV : low voltage winding(s)
 Z : filter (optional)
 Zm : measuring impedance

Either A or B can be earthed (optionally through a filter)
 C and F to be connected to LV whenever possible

Test voltage applied between the high voltage terminal and earth or induced by excitation to the low voltage winding.

FIG. 2 TEST CIRCUIT FOR PARTIAL DISCHARGE MEASUREMENT OF PHASE-TO-EARTH AND PHASE-TO-PHASE VOLTAGE TRANSFORMERS

NOTE TO FIGURES 1 AND 2 — The capacity of the high voltage test transformer may be used as a coupling capacity, in which case the filter Z shall be omitted.

2.2 Phase-to-Phase Voltage Transformers — The test circuit for phase-to-phase voltage transformers shall be the same as for phase-to-earth voltage transformers but two tests shall be performed by applying the test voltages alternately to each of the high voltage terminals with the other terminal connected to a low voltage terminal (*see* Fig. 2).

As an alternative, the correct voltage stressing can be simulated in special test circuits subject to agreement between the manufacturer and the customer.

3. MEASURING INSTRUMENTS

3.1 The measuring instrument used shall comply with **3.4** of IS : 6209-1982*.

*Methods for partial discharge measurement (*first revision*).

3.2 The instrument used will depend on the quality to be measured and the quality preferred in this standard is the apparent charge q expressed in picocoulombs (pC).

NOTE — Wideband measurement of partial discharges with a bandwidth of at least 100 kHz offers certain advantages especially where test objects with distributed capacity and inductance are concerned. Normally, however, a narrow band measurement of partial discharges is sufficient for instrument transformers, particularly if there is a possibility of choosing between measuring frequencies in the range 0.15 MHz to 2 MHz. Preferred values are 0.5 MHz and 1 MHz, but, if feasible, the measurement should be performed at the frequency which gives the highest sensitivity.

4. CALIBRATION

4.1 The calibration of the measuring circuit shall be performed according to 4 of IS : 6209-1982*.

5. TEST PROCEDURE

5.1 The partial discharge test shall be carried out after all dielectric tests are completed. The applied voltage shall be raised to the pretest voltage (values given in Table 1) before reducing it to the partial discharge measuring voltage also given in Table 1.

NOTE — Alternatively, the partial discharge test may be performed while decreasing the voltage after the power frequency withstand voltage. If the measured partial discharge values exceed the permitted limits of Table 1, a separate test as specified above may be carried out.

6. PERMISSIBLE PARTIAL DISCHARGE LEVELS

6.1 Preferred values for the permissible levels of partial discharges are given in Table 1. These values are found by experience to guarantee reasonably reliable products at reasonable cost. Whenever it is possible to clearly distinguish between higher background disturbances and the partial discharges arising from the test object, these higher disturbances may be permissible if agreed by manufacturer and the customer.

*Methods for partial discharge measurement (*first revision*).

TABLE 1 PERMISSIBLE VALUES OF PARTIAL DISCHARGE LEVELS

(*Clauses 5.1 and 6.1*)

| TYPE OF EARTHING (<i>see Note 1</i>) | TYPE OF INSTRUMENT TRANSFORMER | PRE-STRESS VOLTAGE > 10 s (<i>see Note 2</i>) | MEASURING VOLTAGE > 1 mm (<i>see Note 2</i>) | TYPE OF INSULATION | PERMISSIBLE PARTIAL DISCHARGE LEVEL Appartment Charge |
|---|--|--|---|--------------------------|--|
| (1) | (2) | (3) | (4) | (5) | (6) |
| Networks with an isolated or resonant earthing starpoint | Current transformer and phase-to-earth voltage transformer | 1.3 U _m | 1.1 U _m (<i>see Note 3</i>) | Liquid immersed Solid | 100 pC 250 pC |
| | Phase-to-phase voltage transformer | 1.3 U _m | 1.1 U _m $\frac{1.1 U_m}{\sqrt{3}}$ | Liquid immersed Solid | 10 pC 50 pC |
| Networks with an effectively earthing starpoint | Current transformer and phase-to-earth voltage transformer | 0.8 × 1.3 U _m | 1.1 U _m $\frac{1.1 U_m}{\sqrt{3}}$ | Liquid immersed Solid | 10 pC 50 pC |
| | Phase-to-phase voltage transformer | 1.3 U _m | 1.1 U _m | Liquid immersed Solid | 10 pC 50 pC |

NOTE 1 — If there is no clear distinction to be made for which kind of network (starpoint either isolated or effectively earthed) the instrument transformer is meant, the levels for the isolated starpoint shall be taken.

NOTE 2 — Where the rated voltage of a voltage transformer is considerably lower than its declared highest system voltage U_m, then, subject to agreement between manufacturer and customer, lower pre-stress voltages may be chosen.

NOTE 3 — These values apply only if agreed between manufacturer and customer.

(*Continued from page 2.*)

Panel for Measurement of Partial Discharge in Instrument Transformers,
ETDC 34/P2

Convenor

SHRI S. D. JINSIWALE

Members

DIRECTOR (PROTECTION AND
INSTRUMENTATION)

SHRI J. J. DARUWALA

SHRI S. K. LAMBA

SHRI V. V. MOOGI

SHRI J. S. NEGI

SHRI V. B. DESAI (*Alternate*)

SHRI P. U. PATWARDHAN

SHRI M. C. RATRA

SHRI A. V. SOMAN

SHRI B. K. VENKATESH

Representing

Silkaans, Bombay

Central Electricity Authority, New Delhi

All India Instrument Manufacturers and Dealers
Association, Bombay

Volta's Ltd, Thane

Crompton Greaves Ltd, Bombay

Jyoti Ltd, Vadodara

Prayog Electricals Pvt Ltd, Bombay

Central Power Research Institution, Bangalore

Bharat Heavy Electricals Ltd, New Delhi

Karnataka Electricity Board, Bangalore